

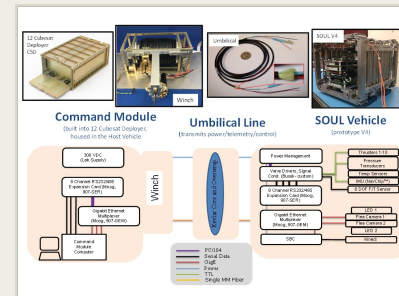
## SOUL System Maturation, Phase II

Completed Technology Project (2016 - 2018)



## Project Introduction

Busek Co. Inc. proposes to advance the maturity of an innovative Spacecraft on Umbilical Line (SOUL) System suitable for a wide variety of applications of interest to NASA, DoD and commercial missions. SOUL is a small (<10kg) robotic, self-propelled, self-navigating, autonomous vehicle equipped with a tool (e.g. gripper, light, camera etc.). The SOUL vehicle/robot is attached via the umbilical line to a larger host spacecraft that stows it in a marsupial-like manner and communicates with ground. The umbilical delivers power and commands to SOUL from the host spacecraft. Conceptually, the SOUL is a tool on the end of tens of meters long robotic arm with infinite degrees of freedom (flexible umbilical) that can access locations unreachable by conventional robotic arms. The initial purpose of the USAF and Navy funded SOUL development was removal of large space debris (1000kg class). Under this program, the development of the SOUL vehicle was extremely successful. The SOUL, tested on an air table, autonomously recognized simulated debris, estimated its pose relative to the target (fusing visible, IR images and IMU information), planned a path to the debris and executed the path and the touched the target with minimal momentum transfer. In Phase 1 of the present program, Busek designed, build and tested a winch that is the key part of the SOUL deployment and retrieval system, panning out or reeling in the umbilical line. In the proposed Phase 2 effort Busek will build the entire SOUL system consisting of the SOUL vehicle, umbilical, the Deployment/Retrieval system and the Command Module. The entire system will be housed for launch in a 6U CubeSat deployer which will also stow SOUL when inactive. Demonstration of the integrated system including the 6U deployer will be performed on the air table. The ultimate goal is to make a flight worthy system and demonstrate it on the ISS. Flight readiness will be achieved by qualifying program on the Phase 2 hardware.



SOUL System Maturation, Phase II

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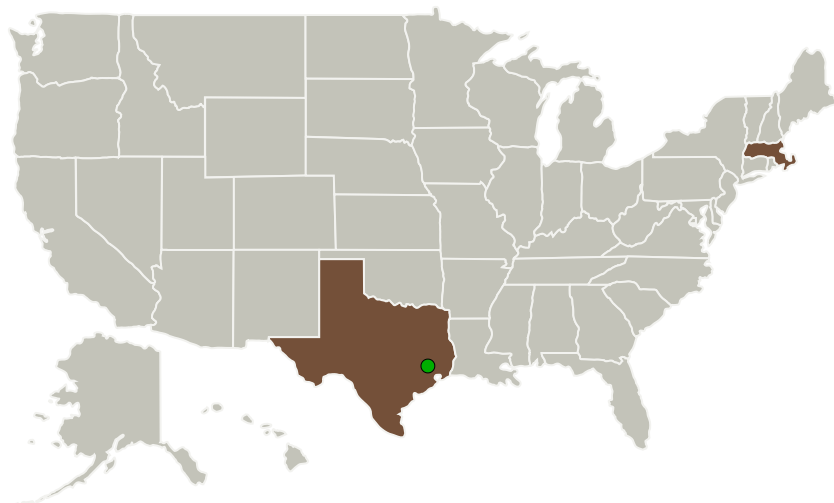
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## Primary U.S. Work Locations and Key Partners




Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

## Primary U.S. Work Locations

Massachusetts	Texas
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## Project Transitions

 **May 2016:** Project Start

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Busek Company, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

Vlad Hruby

**Co-Investigator:**

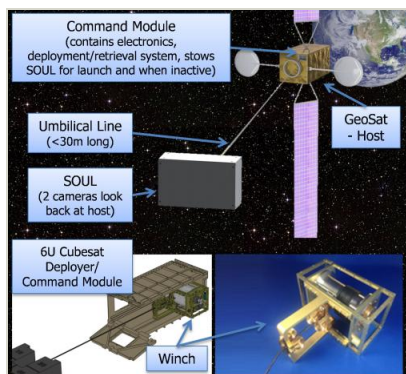
Vlad Hruby

## SOUL System Maturation, Phase II

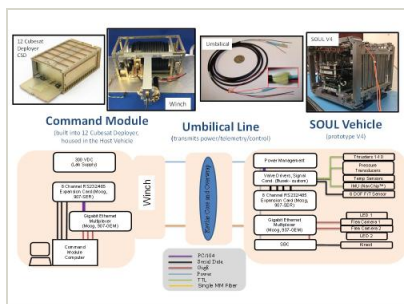
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**November 2018:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/139799>)

**Images****Briefing Chart Image**

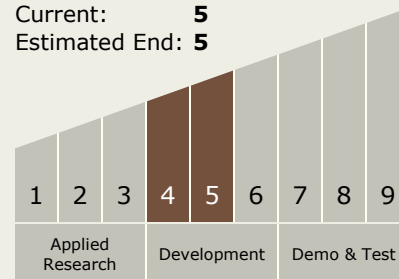
SOUL System Maturation, Phase II  
(<https://techport.nasa.gov/image/127577>)

**Final Summary Chart Image**

SOUL System Maturation, Phase II  
(<https://techport.nasa.gov/image/136348>)

**Technology Maturity (TRL)**

Start: **4**  
Current: **5**  
Estimated End: **5**

**Technology Areas****Primary:**

- TX04 Robotic Systems
  - TX04.2 Mobility
    - TX04.2.6 Collaborative Mobility

**Target Destinations**

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System